2021 Astrophysics Explorers Medium Explorer (MIDEX) Announcement of Opportunity (AO) and Missions of Opportunity (MO)

Concept Study Report (CSR) Evaluation Plan

May 26, 2023

Outline

Approval

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Signed copy on file

Introduction

Introduction

The goal of NASA's Explorers Program is to provide frequent flight opportunities for high quality, high value, focused heliophysics and astrophysics science investigations that can be accomplished under a not-to-exceed cost cap and that can be developed relatively quickly, generally in 36 months or less, and executed on-orbit in less than 3 years.

The purpose of this evaluation plan is to define the ground rules, processes, organizations, and schedules to be used in evaluating the Astrophysics Explorers Concept Study Reports (CSRs).

Two Full Missions and two Missions of Opportunity were selected for concept studies, which constitute each investigation's Concept and Technology Development Phase (Phase A) of the Formulation process as outlined in NPR 7120.5E, NASA Spaceflight Program and Project Requirements.

$3M and 9 months were allocated for each MIDEX Concept Study and $750K and 9 months were allocated for each MO Concept Study.

Evaluation Plan Overview

- The 2021 Astrophysics Explorers competition, under which the investigations to be evaluated were selected, was comprised of two solicitations:
  - **AO NNH21ZDA018O**, entitled *Astrophysics Explorers Program 2021 Medium Explorer (MIDEX)*, issued August 24, 2021, and amended on October 25, 2021.
  - **Program Element Appendix (PEA) Q**, entitled *2021 Astrophysics Explorers Mission of Opportunity*, appended August 24, 2021, to the Third Stand Alone Mission of Opportunity Notice (SALMON-3) AO NNH17ZDA004O. The Mission of Opportunity PEA-Q was amended on October 25, 2021.
- The Science Office for Mission Assessments (SOMA) at NASA Langley Research Center (LaRC) developed this Astrophysics Explorers AO CSR Evaluation Plan for the Science Mission Directorate (SMD) at NASA Headquarters.
- This CSR Evaluation Plan has been cleared for public release by SMD.
- The Astrophysics Explorers Program Scientist is responsible for validating all evaluation processes, responsibility assignments, assumptions, and ground rules.

Two Full Missions were selected for competitive Phase A concept studies. These 2 missions are Class C.

UltraViolet EXplorer (UVEX)

PI: Fiona Harrison, California Institute of Technology, Pasadena, CA

UVEX would conduct a deep survey of the whole sky in two bands of ultraviolet light, to provide new insights into galaxy evolution and the lifecycle of stars. The spacecraft would have the ability to repoint rapidly to capture ultraviolet light from the explosion that follows a burst of gravitational waves caused by merging neutron stars. UVEX would carry an ultraviolet spectrograph for detailed study of massive stars and stellar explosions.

Survey and Time-domain Astrophysical Research Explorer (STAR-X)

PI: William Zhang, NASA Goddard Space Flight Center, Greenbelt, MD

The STAR-X spacecraft would be able to turn rapidly to point a sensitive wide-field X-ray telescope and an ultraviolet telescope at transient cosmic sources, such as supernova explosions and active galaxies. Deep X-ray surveys would map hot gas trapped in distant clusters of galaxies; combined with infrared observations from NASA's upcoming Roman Space Telescope, these observations would trace how massive clusters of galaxies built up over cosmic history.

Two Missions of Opportunity were selected for competitive Phase A concept studies. These 2 missions are Class D.

Moon Burst Energetics All-sky Monitor (MoonBEAM)

Principal investigator: Chiumun Michelle Hui at NASA's Marshall Space Flight Center in Huntsville, Alabama

In its orbit between Earth and the Moon, MoonBEAM would see almost the whole sky at any time, watching for bursts of gamma rays from distant cosmic explosions and rapidly alerting other telescopes to study the source. MoonBEAM would see gamma rays earlier or later than telescopes on Earth or in low orbit, and astronomers could use that time difference to pinpoint the gamma-ray source in the sky.

A LargE Area burst Polarimeter (LEAP)

Principal investigator: Mark McConnell at the University of New Hampshire in Durham

Mounted on the International Space Station, LEAP would study gamma-ray bursts from the energetic jets launched during the formation of a black hole after the explosive death of a massive star, or in the merger of compact objects. The high-energy gamma-ray radiation can be polarized, or vibrate in a particular direction, which can distinguish between competing theories for the nature of the jets.

Handling of Proprietary Data and Avoiding COIs

Handling of Proprietary Data

- All CSR related materials will be considered proprietary.
- Only those individuals with a need to know will be allowed to view CSR materials.
- Each evaluator who is not a Civil Servant (CS) or Intergovernmental Personnel Act (IPA) Assignee will sign a NASA Non-Disclosure Agreement (NDA) which must be on file with the NASA Research and Education Support Services (NRESS) Contractor, or the Evaluations, Assessments, Studies, Services, and Support 3 (EASSS 3) Contractor prior to any CSRs being distributed to that evaluator.
- CS and IPA evaluators are under statutory obligations and are not required to sign an NDA
- A record will be kept of who has been supplied with what materials.
- Evaluators will be briefed at a Kickoff web conference on how to handle the CSR material. Evaluators will be briefed that they are not allowed to discuss CSRs with anyone outside the Evaluation Panels ever, unless authorized by NASA. Evaluators will be briefed to not contact anyone outside of the Evaluation Panels to gain insight on any CSR related matter without expressly getting authorization from the Astrophysics Explorers Program Scientist (Dr. Hannah Jang-Condell). If authorized by the Program Scientist, the Deputy AA for Research should be notified.

Handling of Proprietary Data (continued)

- SPD-17 detailing Observers at Review Panels will be followed. Observers will not have access to CSR or evaluation materials.
- During the Evaluation, all proprietary information that needs to be exchanged between evaluators will be transferred securely via the Remote Evaluation System (RES) website maintained by SOMA, via the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES), via NASA Google docs, via the secure ScienceWorks system maintained by SMD, via controlled WebEx, via NASA's Box file transfer capability, or via encrypted email, parcel post, fax, or regular mail. Proprietary information will not be sent via unencrypted email.
- Virtual meeting information is confidential. The meeting numbers and pass codes are posted in a file on the RES or on Google docs. Participants will be briefed to ensure they do not provide this information to anyone or distribute this information via unencrypted email or text messages.
- When the evaluation process is complete, CSR materials will be collected. Some copies (for archival purposes) will be maintained by the Program Scientist at NASA HQ, and in the SOMA vault. Also, all CSR material from the down-selected mission(s) will be provided to the Explorers Program Office at GSFC. All other CSR materials will be destroyed.
- Evaluators' electronic and paper evaluation materials will be deleted/destroyed when the evaluation process is complete. Archival copies will be maintained in the SOMA vault.

Plan to Avoid Conflicts of Interest (COIs)

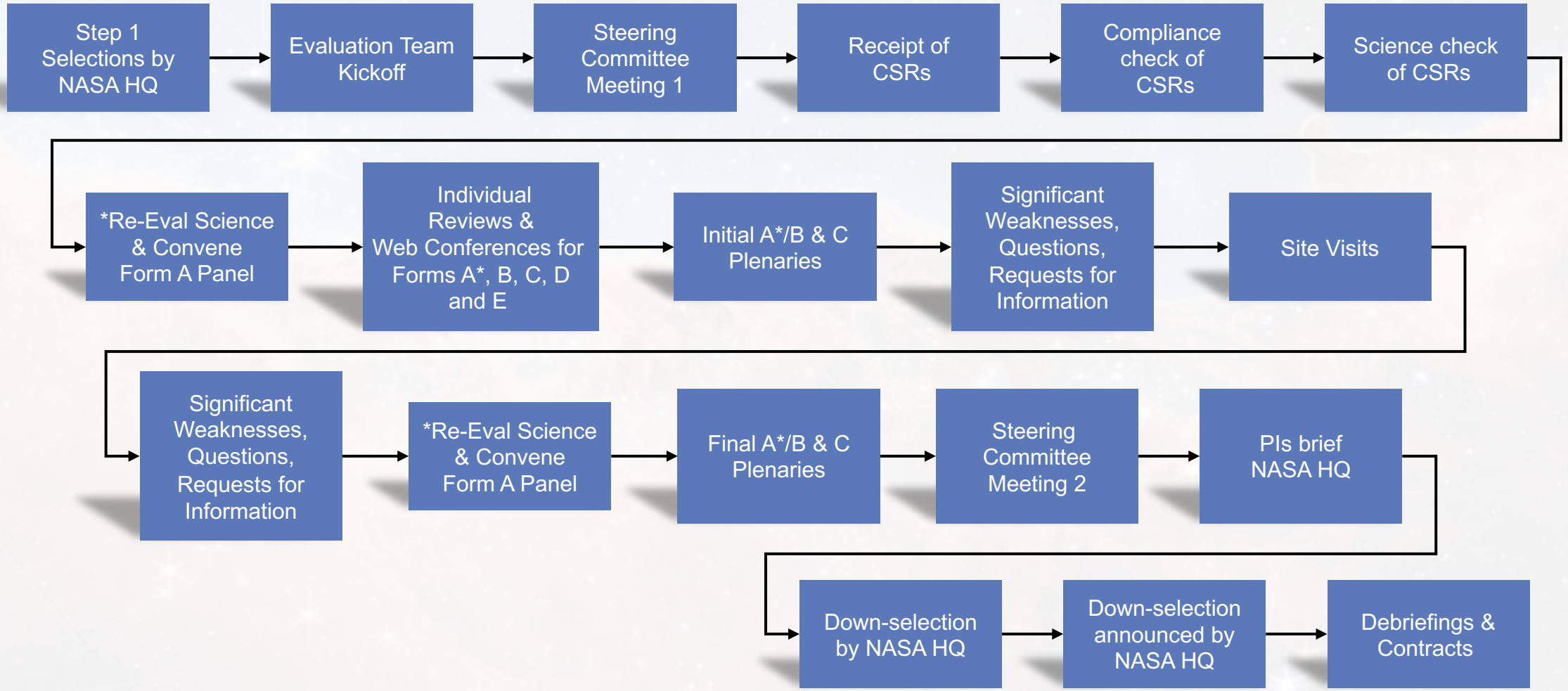
- Members of Evaluation Panels are cross checked against the draft list of organizations and individuals provided by the study teams to ensure no individual or organizational COI exists with the planned evaluators. Evaluators are required to raise any potential COIs.
- After the Concept Study Reports (CSRs) are received, all members of the Evaluation Panels will again be cross checked against the final lists of organizations and individuals on each CSR to ensure no individual or organizational COI exists on the list of evaluators.
- In addition, all evaluators will review the final lists of conflicted organizations and individuals and be required to divulge whether they have any financial, professional, or personal potential conflicts of interest and whether they work for a profit-making company that directly competes with any profit-making proposing organization.
- Community standards for conflicts of interest will be applied to all evaluators as directed in SMD Policy Document SPD-01A, Handling Conflicts-of-Interest for Peer Reviews. Standards for financial conflicts of interest as specified in 18 U.S.C. § 208 will be applied to Civil Servant evaluators. The HQ Office of General Counsel will be consulted as necessary.

Plan to Avoid COIs (continued)

- Any potential COI issue is discussed with the Astrophysics Program Scientist and the SMD Deputy Associate Administrator for Research and documented in the Astrophysics Explorers Downselect COI Mitigation Plan.
- All Civil Service evaluators will self-certify their COI status by reviewing a combined listing of individuals and organizations associated with the CSRs. The TMC evaluators must notify the TMC Panel Chair in case there is a potential conflict. The Science evaluators must notify the Science Panel Chair in case of a potential conflict.
- If any evaluators with potential organizational COI must be used, their respective organizations must submit a plan, as required by their contract or SMD waiver, and also provide a mitigation plan.
- If during the evaluation there is any actual conflict of interest noted, the conflicted member(s) will be notified to stop reviewing CSRs immediately and the Astrophysics Explorers Program Scientist will be notified. Steps will be expeditiously taken to remove any actual or potential bias imposed by the conflicted member(s).

Evaluation Process and Organization

CSR Evaluation Flow



***If required due to change in Science. If not required, use Forms A from Step 1.**

Evaluation Organization

Leadership Team

Dr. Hannah Jang-Condell, Program Scientist
Dr. Doris Daou, Deputy Program Scientist
Dr. Linda Sparke, Deputy Program Scientist
Dr. Patricia Knezek, Deputy Program Scientist
NASA Headquarters

James Florance, Lead Acquisition Manager
Dr. Carlos Liceaga, Acquisition Manager
Odilyn Luck, Backup Acquisition Manager
SOMA, NASA Langley Research Center

Science Panel (Forms A & B)
Chair: Dr. Hannah Jang-Condell
Co-Chair: Dr. Doris Daou
Advisor: Dr. Linda Sparke
Advisor: Dr. Patricia Knezek

TMC Panel (Form C)
Chair: James Florance
Co-Chair: Dr. Carlos Liceaga
Backup: Odilyn Luck

Student Collaboration
(Form D)
Chair: Dr. Hashima Hasan

Small Business Subcontracting
(Form E)
Natalie Colvin
Robert E. Watts

Evaluation Criteria

Evaluation Criteria and Additional Selection Factors

- The Criteria to Evaluate the Concept Study Reports are documented in the 2021 ASTROPHYSICS EXPLORER GUIDELINES AND CRITERIA FOR THE PHASE A CONCEPT STUDY at:

  https://explorers.larc.nasa.gov/2021APMIDEX/pdf_files/GuidelinesCriteria_2021Astro_Rev7_amended_9May2023.pdf

- **Evaluation criteria for the Concept Study:** approximate significance of each criterion is indicated by the percent weighting.
  - Criterion A: Scientific Merit of the Proposed Investigation (will not be reevaluated unless it is determined that the science has changed from that described in the Step 1 proposal) (approximately 20%)
  - Criterion B: Scientific Implementation Merit and Feasibility of the Proposed Investigation (approximately 40%)
  - Criterion C: TMC Feasibility of Mission Implementation (approximately 40%)

- **Additional Selection Factors that may be considered by the Selection Official**
  - Criterion D and E: Student Collaboration (SC) and Small Business Subcontracting Plans will be evaluated as separate factors and considered during the selection process.
  - At the continuation decision (i.e., the final down-selection), it may be necessary for the Selection Official to consider NASA budget changes and/or other programmatic factors, including but not limited to changes in scientific mandates, national priorities, and budgetary forecasts that were not evident when the AO or the PEA were issued. The PI-Managed Mission Cost, as well as other programmatic factors, may be additional selection factors.

Evaluation Criterion A

Scientific Merit of the Proposed Investigation:

The Astrophysics Explorers Program Scientist will determine whether any issues that may have emerged in the course of the concept study have effected significant changes to the science objectives or other aspects of the proposed Baseline and Threshold Science Missions (see Requirement CS-17 in Section II of the 2021 Astrophysics Explorers Guidelines and Criteria for the Phase A Concept Study) in such a manner as to have impacted the basis for the evaluation of the scientific merit of the investigation as determined by the peer review panel for the Step 1 proposal. If there are no significant changes to the proposed investigation that undermine the basis of this rating, the peer review panel rating for scientific merit of the Step 1 proposal will be the rating for scientific merit of the CSR. If there are significant changes, the Program Scientist will convene a peer review panel to re-evaluate the scientific merit of the objectives in light of these changes. The factors for re-evaluating this criterion will be the same as those used for the Step 1 proposal review (Section 7.2.2 of both the MIDEX AO and the SALMON-3 AO, or Section 7.1 of the PEA).

Evaluation Criterion B

Scientific Implementation Merit and Feasibility of the Investigation: All of the factors defined in Section 7.2.3 of the MIDEX AO and the SALMON-3 AO or Section 7.1 of the PEA apply to the evaluation of the CSR. For missions of opportunity, “mission” should be replaced with “investigation,” as applicable. Note that details have been added to one of the subfactors of Factor B-1, Merit of the instruments and mission design. *New factors and details added to Step-1 AO factor definitions are highlighted using italicized text for the evaluation of the CSR*.

Factor B-1. Merit of the proposed mission architecture, instruments, and measurement techniques for addressing the goals and meeting the science objectives. This factor includes how well the anticipated measurements support the goals and objectives; the appropriateness of the selected instruments and mission architecture for addressing the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring scientific success.

Factor B-2. Probability of technical success. This factor includes the maturity and technical readiness of the instruments or demonstration of a clear path to achieve necessary maturity; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team – both institutions and individuals – to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the mission design. *This factor includes assessment of technology readiness, heritage, environmental concerns, accommodation, and complexity of interfaces for the instrument design.*

Evaluation Criterion B (continued)

Factor B-3. Data adequacy, analysis, and archiving. This factor includes the degree to which the proposed mission and instruments can provide the quality and quantity of data necessary to complete the investigation and meet the proposed science objectives. Additionally, it includes the merit of data analysis plans, including the fidelity of physical models required to connect the measurements to the science objectives; and plans for archiving, to preserve data and analysis of value to the science community. Considerations include planning and budget adequacy, with plans for well-documented, high-level data products and software usable to the entire science community; adequate resources for physical interpretation of data; reporting scientific results in the professional literature (e.g., refereed journals); and timely release of the data to the public domain.

Factor B-4. Science resiliency. This factor includes both developmental and operational resiliency. Developmental resiliency includes the approach to descoping the Baseline Science Mission to the Threshold Science Mission in the event that development problems force reductions in scope. Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.

Factor B-5. Probability of science team success. This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team and the mission design in light of any proposed instruments. The role of each Co-Investigator (Co-I) will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well-defined and appropriate role may be cause for downgrading during evaluation. *For the MO investigations only: the scientific expertise of the PI will be evaluated but not his/her experience with space missions. Comments about the managerial experience of the PI, and whether appropriate mentoring and support tools are in place, will be made to the Selecting Official but these comments shall not impact the investigation's Scientific Implementation Merit rating.*

Evaluation Criterion B (continued)

Two new evaluation factors that are not described in the AO, and therefore were not evaluated for Step-1 proposals, will also be considered. Factors B-6 and B-7 will be evaluated for the CSRs in addition to the factors specified in Section 7.2.3 of the AO (repeated or updated above as Factors B-1 through B-5).

Factor B-6. Scientific Implementation Merit and Feasibility of any Science Enhancement Options (SEOs), if proposed. This factor includes assessing the appropriateness of the selected activities to enlarge the science impact of the mission and the costing of the selected activities. Although evaluated by the same panel as the balance of Scientific Implementation Merit and Feasibility factors, this factor will not be considered in the overall criterion rating.

Factor B-7. Maturity of proposed Level 1 science requirements and Level 2 project requirements. This factor includes assessment of whether the Level 1 science requirements are mature enough to guide the achievement of the objectives of the Baseline Mission and the Threshold Mission, and whether the Level 2 requirements are consistent with the Level 1 requirements. The Levels 1 and 2 requirements will be evaluated for whether they are stated in unambiguous, objective, quantifiable, and verifiable terms that do not conflict and for whether they are traceable to the science objectives. They will be evaluated for the adequacy, sufficiency, and completeness, including their utility for evaluating the capability of the instruments and other systems to achieve the mission objectives. The stability of the Level 1 science requirements and Level 2 project requirements will be assessed including whether the requirements are ready, upon initiation of Phase B, to be placed under configuration control with little or no expected modifications for the lifecycle of the mission.

The panel evaluating the "Science Implementation Merit and Feasibility" will provide comments to NASA regarding the extent to which the proposed investigation provides career development opportunities to train the next generation of science leaders. While these comments will not be considered in the evaluation, they may be considered during selection.

Evaluation Criterion C

TMC Feasibility of the Mission Implementation, including Cost Risk

- All of the factors defined in Section 7.2.4 of both the MIDEX AO and the SALMON-3 AO or Section 7.1 of the PEA apply to the evaluation of the CSR. All of these factors are interpreted as including an assessment as to whether technical, management, and cost feasibility are at least at a Phase A level of maturity.
- Blue italicized details are added to several factor definitions below for the evaluation of the CSR.
- Note that the risk management aspects of Factor C-4, Adequacy and robustness of the management approach and schedule, including the capability of the management team, have been removed from Factor C-4 and included in a new evaluation factor, Factor C-6. Adequacy of the risk management plan.
- For the MO investigations, which are Class D, the capability of the management team will be evaluated as a whole, as opposed to assessing the capabilities of each of the Key Management Team members independently. The panel evaluating the “Technical, Management, and Cost Feasibility” will provide comments to the Selection Official about the mission experience of the PI and whether appropriate mentoring and support tools are in place.

Evaluation Criterion C (continued)

Factor C-1. Adequacy and robustness of the instrument implementation plan. The maturity and technical readiness of the instrument complement will be assessed, as will the ability of the instruments to meet mission requirements. This factor includes an assessment of the instrument design, accommodation, interface, heritage, and technology readiness. This factor includes an assessment of the instrument hardware and software designs, heritage, and margins. This factor includes an assessment of the proposer's understanding of the processes, products, and activities required to accomplish development and integration of the instrument complement. This factor also includes adequacy of the plans for instrument systems engineering and for dealing with environmental concerns. This factor includes an assessment of plans for the development and use of new instrument technology, plans for advanced engineering developments, and the adequacy of backup plans to mature systems within the proposed cost and schedule when systems having a TRL less than 6 are proposed.

Evaluation Criterion C (continued)

Factor C-2. Adequacy and robustness of the mission design and plan for mission operations. This factor includes an assessment of the overall mission design and mission architecture, the spacecraft design and design margins (including margins for launch mass, delta-V, and propellant), the concept for mission operations (including communication and navigation/tracking/trajectory analysis), and the plans for launch services. This factor includes mission resiliency – the flexibility to recover from problems during both development and operations – including the technical resource reserves and margins, system and subsystem redundancy, and reductions and other changes that can be implemented without impact to the Baseline Science Mission.

Factor C-3. Adequacy and robustness of the flight systems. This factor includes an assessment of the flight hardware and software designs, heritage, and margins. This factor includes an assessment of the proposer's understanding of the processes, products, and activities required to accomplish development and integration of all elements (flight systems, ground and data systems, etc.). This factor includes an assessment of the adequacy of the plans for spacecraft systems engineering, qualification, verification, mission assurance, launch operations, and entry/descent/landing. This factor includes the plans for the development and use of new technology, plans for advanced engineering developments, and the adequacy of backup plans to ensure success of the mission when systems having a TRL less than 6 are proposed. The maturity and technical readiness of the spacecraft, subsystems, and operations systems will be assessed. The adequacy of the plan to mature systems within the proposed cost and schedule, the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks, and the likelihood of success in developing any new technologies will be assessed.

Evaluation Criterion C (continued)

Factor C-4. Adequacy and robustness of the management approach and schedule, including the capability of the management team. This factor includes: the adequacy of the proposed organizational structure and WBS; the management approach including project level systems engineering; the roles, qualifications, and experience of the PI, PM, PSE, other named Key Management Team members, and implementing organization, mission management team, and known partners; the commitment, spaceflight experience, and relevant performance of the PI, PM, PSE, other named Key Management Team members, and implementing organization, mission management team, and known partners against the needs of the investigation; the prior working relationship of the implementing organization and known partners; the commitments of partners and contributors; and the team's understanding of the scope of work covering all elements of the mission, including contributions. ~~Also evaluated under this factor is the adequacy of the proposed risk management approach, including any risk mitigation plans for new technologies, any long-lead items, and the adequacy and availability of any required manufacturing, test, or other facilities. The approach to any proposed descoping of mission capabilities will be assessed against the potential science impact to the proposed Baseline Science Mission. The plans for managing the risk of contributed critical goods and services will be assessed, including the plans for any international participation, the commitment of partners and contributors, as documented in Letters of Commitment, and the technical adequacy of contingency plans, where they exist, for coping with the failure of a proposed cooperative arrangement or contribution.~~ This factor also includes assessment of elements such as the relationship of the work to the project schedule, the project element interdependencies, the associated schedule margins, and an assessment of the likelihood of meeting the proposed launch readiness date. Also evaluated under this factor are the proposed project and schedule management tools to be used on the project, *along with the effect of the small business subcontracting plan including small, disadvantaged businesses*.

Evaluation Criterion C (continued)

<u>Factor C-5.</u> Adequacy and robustness of the cost plan, including cost feasibility and cost risk. This factor includes elements such as cost, cost risk, cost realism, and cost completeness including assessment of the basis of estimate, the adequacy of the approach, the methods and rationale used to develop the estimated cost, *the methods and rationale used to develop the estimated cost,* the discussion of cost risks, the allocation of cost reserves by phase, and the team's understanding of the scope of work (covering all elements of the mission, including contributions). The adequacy of the cost reserves and understanding of the cost risks will be assessed. This factor also includes an assessment of the proposed cost relative to estimates generated by the evaluation team using parametric models and analogies. Also evaluated under this factor are the proposed cost management tools to be used on the project. *Also evaluated under this factor are the proposed cost management tools to be used on the project.*

Evaluation Criterion C (continued)

The following evaluation factor has been removed as a subset of Factor C-4 described in the AO or the PEA and has been revised for the evaluation of the CSR.

Factor C-6. Adequacy of the risk management plan. The adequacy of the proposed risk management approach will be assessed, including any risk mitigation plans for new technologies, any long-lead items, and the adequacy and availability of any required manufacturing, test, or other facilities. *The approach to any proposed descoping of mission capabilities will be assessed against the potential science impact to the proposed Baseline Science Mission.* The plans for managing the risk of contributed critical goods and services will be assessed, including the plans for any international participation, the commitment of partners and contributors, as documented in Letters of Commitment, and the technical adequacy of contingency plans, where they exist, for coping with the failure of a proposed cooperative arrangement or contribution; *when no mitigation is possible, this should be explicitly acknowledged. The stability and reliability of proposed partners, and the appropriateness of any proposed contribution, is not assessed as a management risk but will be assessed by SMD as a programmatic risk element of the investigation.*

Evaluation Criterion C (continued)

The following are new evaluation factors that are not described in the AO or the PEA and were therefore not evaluated for Step 1 proposals. These will be evaluated for the CSRs in addition to the factors given in Section 7.2.4 of both the MIDEX AO and the SALMON-3 AO, or Section 7.1 of the PEA and repeated or updated above as Factors C-1 through C-6.

Factor C-7. Ground systems. This factor includes an assessment, including heritage and planned new development, of the proposed operations facilities, hardware, and software (i.e., those for mission operations and science operations), and a telecommunications analysis, ground network capability and utilization plan, and navigation plans.

Factor C-8. Approach and feasibility for completing Phase B. The completeness of Phase B plans and the adequacy of the Phase B approach will be assessed. This assessment will include evaluation of the activities/products, the organizations responsible for those activities/products, and the schedule to accomplish the activities/products.

- **For the purpose of the CSR, investigation teams are not required to hold reserves against Government Furnished Equipment (GFE) such as an AO-provided Launch service. They should assume the Government will deliver as promised on factors such as Launch Vehicle (LV) performance and schedule. The Government is holding separate reserves on its promises.**
- **The panel evaluating the "Technical, Management, and Cost Feasibility" will provide comments to NASA regarding the extent to which the proposed investigation provides career development opportunities to train the next generation of engineering and management leaders. While these comments will not be considered in the evaluation, they may be considered during selection.**

Evaluation Criteria D & E

The following are new evaluation factors that are not described in the AO or the PEA and therefore were not evaluated for Step-1 proposals. These will be evaluated for CSRs.

Evaluation Criterion D

Merit of Student Collaboration (SC), if proposed. This factor will include an assessment of whether the scope of the SC follows the guidelines in Section 5.5.3 of the MIDEX AO or Section 5.6.2 of the SALMON-3 AO. The criteria to be used to evaluate the SC component and a discussion of those criteria are found in those AO sections and follow Science Policy Document SPD-31 available in the Program Library.

- There is no minimum and no maximum allowable cost for a SC. NASA is providing a SC option that is defined to be 1% of the PIMMC. The proposed cost of the SC, up to the SC incentive, is considered outside of the PIMMC. If the SC costs NASA more than the SC incentive, then the balance of the NASA cost of the SC must be within the PIMMC. SC incentive, as an addition to the mission's implementation, is not available to solve mission cost overrun issues. The SC provides no cost savings to a NASA investigation.
- TMC will review the SC and if an SC is deemed separable, no comments will be provided in Form C and if an SC is not deemed separable by the TMC, technical, management, and cost considerations will be reviewed like any other aspect of the mission.

Evaluation Criterion E

Merit of the Small Business Subcontracting Plans. This factor will be evaluated on the participation goals and quality and level of work performed by small business concerns overall, as well as that performed by the various categories of small business concerns listed in FAR 52.219-9.

Evaluation Products and Ratings

CSR Evaluation Panel Products

Form A (if necessary) and Form B for all CSRs

- Grades: Excellent, Excellent/Very Good, Very Good, Very Good/Good, Good, Good/Fair, Fair, Fair/Poor, or Poor
- Polling is held for the 9 categories above.
- The reported grade reflects the median.
  - A median score that falls between two grades will be “rounded” in the direction of the mean score; if mean and median are equal, the score will be “rounded” towards the less favorable grade.

Form C for all CSRs

- Risk rating range: Low Risk, Low/Medium Risk, Medium Risk, Medium/High Risk, or High Risk
- Polling is held for the 5 categories.
- The reported Risk Rating grade reflects the median.
  - A median score that falls between two risk ratings will be “rounded” to the higher risk rating.

Form D (Student Collaboration)

- Separable from the main mission: Yes or No (evaluated by Form C panel)
- Grades: Meritorious or Not Meritorious

Form E (Small Business Subcontracting Plans)

- Grades: Acceptable or Needs Work

Grade Definitions - Forms A and B

Form A and B Grade Definitions

- **Excellent:** A comprehensive, thorough, and compelling CSR of exceptional merit that fully responds to the objectives of the AO as documented by numerous and/or significant strengths and having no major weaknesses.
- **Very Good:** A fully competent CSR of very high merit that fully responds to the objectives of the AO, whose strengths fully outbalance any weaknesses.
- **Good:** A competent CSR that represents a credible response to the AO, having neither significant strengths nor weaknesses and/or whose strengths and weaknesses essentially balance.
- **Fair:** A CSR that provides a nominal response to the AO, but whose weaknesses outweigh any perceived strengths.
- **Poor:** A seriously flawed CSR having one or more major weaknesses (e.g., an inadequate or flawed plan of research, or lack of focus on the objectives of the AO).

Evaluators are polled on the grades defined above and may also use half-grades between these defined above.

Definitions of Criterion A*/B Findings

Major Strength: A facet of the response that is judged to be well above expectations and substantially contributes to the Science Implementation Merit and Feasibility of the Investigation.

Minor Strength: A strength that contributes to the Science Implementation Merit and Feasibility of the Investigation.

Major Weakness: A deficiency or set of deficiencies taken together that are judged to substantially detract from the Science Implementation Merit and Feasibility of the Investigation.

Minor Weakness: A weakness that detracts from the Science Implementation Merit and Feasibility of the Investigation.

Unlike in Step 1, minor findings can influence ratings. Significant minor findings are those minor findings that do influence ratings and are specifically identified in evaluation forms, and will be marked as such in the Form B. The term "Significant Weakness" includes both Major Weaknesses and Significant Minor Weaknesses.

If required due to change in Science. If not required, use Forms A from Step 1.

Risk Ratings Definitions - Form C

The following definitions are indicators of risk. Evaluators must consider these definitions and input available for their consideration (e.g., cost model applicability, uncertainty of the cost models error bars and schedule analyses, uncertainty of the cost threats, mitigating factors such as major strengths, etc.) together with their judgement in determining the appropriate risk for a particular investigation.

Rating	Definition
Low Risk	Resources for technical, management, schedule, and cost are at or above the appropriate levels, with at least one resource significantly above, even after taking into account any problems that have been identified in the Phase A evaluation. No risks with unquantified cost threats* have been identified.
Low/Medium Risk	No problems have been identified in the Phase A evaluation that reduce the technical, management, schedule, and cost resources below the appropriate levels. Any identified risks with unquantified cost threats have a low probability of occurrence.
Medium Risk	Problems have been identified in the Phase A evaluation that reduce one of the resources slightly below the appropriate levels for: technical, management, schedule, or cost. Sound management and effective application of engineering resources will be required to solve the problems. Any identified risks with unquantified cost threats have a probability of occurrence that is not high.
Medium/High Risk	Problems have been identified in the Phase A evaluation that reduce one or more of the resources below the appropriate levels for: technical, management, schedule, and/or cost. The problems identified may not be solvable within the resources proposed, even with the use of sound management and effective application of engineering resources.
High Risk	Problems have been identified in the Phase A evaluation that reduce one or more of the resources significantly below the appropriate levels for: technical, management, schedule, and/or cost. The problems identified are deemed unsolvable within the resources proposed.

***Risks with unquantified cost threats** are defined in the grades above as those major weaknesses whose cost to fix cannot be quantified, but is large. The impacts of these risks are significant because they could lead to not achieving the baseline mission with the resources available.*

Criterion C Panel Evaluation Principles –

- **CSR Feasibility and Risk Assessment in Step 2:**
  - The criterion C Panel's task is to assess the feasibility of implementing the mission or investigation based on all the material provided by the Phase A concept study team.
  - *The study team is not given the benefit of the doubt in the down-select.*
- All CSRs will be reviewed to identical standards.
  - All CSRs shall receive same evaluation treatment in all areas.
- The Criterion C Panel is made up of evaluators who are subject matter experts in the areas of the CSRs that they evaluate.
- The Criterion C Panel develops findings for each CSR that are based on individual comments and reflect the general agreement of the entire panel.
  - Comments that are *as expected* are not included as findings.
  - Comments that are *above expectations* result in strengths.
  - Comments that are *below expectations* result in weaknesses.

Definitions of Criterion C Findings

Major Strength: A facet of the response that is judged to be well above expectations and can substantially contribute to the ability to meet technical commitments on schedule and within cost.

Minor Strength: A strength that is substantial enough to be worthy of note and brought to the attention of study team in debriefings.

Major Weakness: A deficiency or set of deficiencies taken together that are judged to substantially affect the ability to meet the proposed technical objectives within the proposed cost and schedule.

Minor Weakness: A weakness that is substantial enough to be worthy of note and brought to the attention of study team in debriefings.

Unlike in Step 1, minor findings can influence risk ratings. Significant minor findings are those minor findings that do influence risk ratings and are specifically identified in evaluation forms, and will be marked as such in the Form C. The term "Significant Weakness" includes both Major Weaknesses and Significant Minor Weaknesses.

Cost Evaluation

- All information from the entire evaluation process will be considered in the final cost assessment.
- An independent cost verification of the proposed cost for Phases A-D will be performed using three independent cost models.
- An independent cost verification of the proposed cost for Phase E will be performed using at least two cost models.
- The evaluation will assess the cost risk, cost realism, and cost completeness, including the basis of estimate, the adequacy of the approach, the methods and rationale used to develop the estimated cost, the discussion of cost risks, the allocation of cost reserves by phase, and the team's understanding of the scope of work.
- The likelihood and cost impact of significant weaknesses and cost analysis findings will be assessed.
- Cost threat impacts to the proposed unencumbered reserves will be assessed (see Cost Threat Matrix slides 41 and 42).
- The adequacy of the remaining unencumbered reserves will be assessed.
- Draft Forms C and Cost Evaluation Summaries (CESs) will be completed on all CSRs prior to the Initial Form C Plenary.
- During the Form C Plenaries, the entire panel will participate in Cost deliberations.
- All significant Cost Findings will be included on the Form C and considered in the TMC Risk Rating.

Full Mission (MIDEX) Cost Threat Matrix

- The *likelihood and cost impact*, if any, of each weakness is stated as "This finding represents a cost threat assessed to have a(n) Unlikely/Possible/Likely/Very Likely/Almost Certain likelihood of a Very Minimal/Minimal/Limited/Moderate/Significant/Very Significant cost impact being realized during development and/or operations, which results in a reduction from the proposed unencumbered reserves."
- The *likelihood* is the probability range that the cost impact will materialize.
- The *cost impact* is the current best estimate of the range of costs to mitigate the realized threat.
- The cost threat matrix below defines the adjectives used to describe the *likelihood and cost impact*.
- The *minimum* cost threat threshold for Phase E is $1M.

		Cost Impact (CI, % of PI-Managed Mission Cost to complete Phases A/B/C/D or *% of Phase E* not including unencumbered cost reserves or contributions)					
		Very Minimal	**Minimal**	**Limited**	**Moderate**	**Significant**	**Very Significant**
		0.5% < CI ≤ 2.5%	2.5% < CI ≤ 5% *2.5% < CI ≤ 5%*	5% < CI ≤ 10% *5% < CI ≤ 10%*	10% < CI ≤ 15% *10% < CI ≤ 15%*	15% < CI ≤ 20% *15% < CI ≤ 20%*	CI > 20% *CI > 20%*
Likelihood (L, %)	Almost Certain (L > 80%)						
	Very Likely (60% < L ≤ 80%)						
	Likely (40% < L ≤ 60%)						
	Possible (20% < L ≤ 40%)						
	Unlikely (L ≤ 20%)						

Note: For each CSR, the percentages in the above table will be converted to dollars by the cost estimator.

Missions of Opportunity (MO) Cost Threat Matrix

- The *likelihood and cost impact*, if any, of each weakness is stated as "This finding represents a cost threat assessed to have a(n) Unlikely/Possible/Likely/Very Likely/Almost Certain likelihood of a Very Minimal/Minimal/Limited/Moderate/Significant/Very Significant cost impact being realized during development and/or operations, which results in a reduction from the proposed unencumbered reserves."
- The *likelihood* is the probability range that the cost impact will materialize.
- The *cost impact* is the current best estimate of the range of costs to mitigate the realized threat.
- The cost threat matrix below defines the adjectives used to describe the *likelihood* and *cost impact*.
- The minimum cost threat threshold is $400K for Phases B/C/D and $250K for Phase E.

		Cost Impact (CI) % of the PI-Managed Mission Cost to complete phases B/C/D or % of Phase E not including unencumbered cost reserves or contributions				
		Minimal ($0.40M < CI ≤ 5%) ($0.25M < CI ≤ 5%)	Limited (5% < CI ≤ 10%) (5% < CI ≤ 10%)	Moderate (10% < CI ≤ 15%) (10% < CI ≤ 15%)	Significant (15% < CI ≤ 20%) (15% < CI ≤ 20%)	Very Significant (CI > 20%) (CI > 20%)
Likelihood (L, %)	Almost Certain (L > 80%)					
	Very Likely (60% < L ≤ 80%)					
	Likely (40% < L ≤ 60%)					
	Possible (20% < L ≤ 40%)					
	Unlikely (L ≤ 20%)					

Note: For each CSR, the percentages in the above table will be converted to dollars by the cost estimator.

Grade Definitions - Form D, Student Collaboration (SC)

The merit of any Student Collaboration (SC) will be given a Yes/No grade and one of two adjectives: Meritorious, or Not Meritorious

- **Is the SC separable from the Baseline and Threshold missions?** (Yes/No)

- **Meritorious:** The student collaboration proposed has achievable education goals and objectives and an implementation/oversight/management approach that will provide students with a rich hands-on education experience.

- **Not Meritorious:** The student collaboration proposed has not articulated achievable education goals and objectives and/or the implementation/oversight/management approach limits the likelihood of success for student's opportunities for hands-on experience.

Grade Definitions - Form E, Small Business Subcontracting

The merit of the Small Business Subcontracting Plans will be rated as either Acceptable, or Needs Work

- **Acceptable:** The subcontracting plan adequately addresses all required elements of a subcontracting plan, and the proposed subcontracting percentage goals and the quality level of the work to be performed by small business concerns is sufficient.

- **Needs Work:** The subcontracting plan does not address all required elements of a subcontracting plan, or the proposed subcontracting percentage goals and quality of work to be performed by small businesses is not sufficient, and further participation must be negotiated if this mission is selected.

Evaluation Procedures

Criteria A*, B & C Panel Evaluation Processes

- Evaluation panel members review assigned CSRs and perform an individual review before discussing findings with other members of the panel.
- NASA Google docs will be used for:
  - Entering individual evaluation panel members' comments for Criteria A* and B.
  - Developing draft and final Forms A* and B for each CSR.
- Evaluation and polling on Forms A* and B will be restricted to Form A* and B Evaluators.
- Only Evaluators who have participated in the Form A*/B Initial Plenary and the Form A*/B Final Plenary may participate in polling on Form A*/B.
  - Participation is defined as in-person or virtually
  - Specialist Evaluators** are not polled
  - Note that Form C evaluators may also be designated as Form B evaluators by the Astrophysics Program Scientist.
- The SOMA RES will be used for:
  - Entering individual evaluation panel member's comments for Criterion C.
  - Developing draft and final Forms C for each CSR.
  - A repository for all final Forms for the evaluation (Forms A*, B, C, D, and E).
- Only Evaluators who have participated in the Form C Initial Plenary, the Site Visits, and the Form C Final Plenary may participate in polling on Form C.
  - Participation is defined as in-person or virtually.
  - Specialist Evaluators** are not polled.
  - Note that some Form B evaluators may also be designated as Form C evaluators by the Astrophysics Program Scientist.

** If required due to change in Science.*

***Specialist Evaluators (to provide special technical expertise to Criterion B/C/D/E Panels) may be utilized, based on the specific technology and science that is proposed.*

Criteria B & C Panel Evaluation Processes (continued)

Consistency Review for Form C findings and Form B findings to ensure similar findings are treated the same across different CSRs (e.g., major vs minor for similarly worded findings) or conflicts between strengths and weaknesses within an individual form.

- **Form C consistency**
  - A Form C Consistency Group will review all Form Cs and questions at the Initial Plenary, and all Form Cs at the Final Plenary.
    - Form C Evaluators will review all CSRs for Full Missions, Missions of Opportunity, or both. Specialist Evaluators may review a subset of CSRs for Full Missions, Missions of Opportunity, or both.
- **Form B consistency**
  - Form B Consistency Checker(s) will review all Form Bs and questions at the Initial Plenary, and all Form Bs at the Final Plenary.
- **Form B and Form C consistency**
  - At least one Form B Evaluator for each CSR will participate in the Form C discussions for each mission at the plenary meetings
  - Some Form C instrument experts will participate in Form B discussions.
  - Consistency of findings between Forms B and C will be reviewed and adjudicated at the Initial and Final Plenaries.

Initial Plenary

The Initial Plenary is used to identify significant issues related to Criterion A (if needed), Criterion B and Criterion C based on the initial evaluation of the CSR. Initial Form Bs and Cs are reviewed.

- The Goal of the Initial Plenary is:
  1. Identify the Major Weakness, Minor Weaknesses, Major Strengths and Minor Strengths of each CSR.
  2. If necessary, develop questions and/or requests for information in addition to the Significant Weaknesses to give each Study Team an opportunity to clarify any misunderstanding.
- The main topic areas are the implementation issues in Criterion B and Criterion C.
- No polling on grades occurs at the Initial Plenary (Criterion B and Criterion C).
- The Significant Weaknesses, Questions, and Requests for Information List (SQRL) will be sent to each Study Team at least 7 days prior to its Site Visit.
- Criterion D (Student Collaboration) and Criterion E (Small Business Subcontracting) are reviewed as required by Criterion-specific panels prior to the Initial Plenary. Site Visit questions for Criterion D and Criterion E are prepared and provided no later than the Initial Plenary to the Astrophysics Explorers Program Scientist.

Significant Weaknesses, Questions, and Requests for Information List (SQRL)

- **Site Visits SQRLs**
  - All SQRLs developed at the Initial Plenary will be sent to each Study Team at least 7 days prior to its Site Visit, excluding federal holidays.
  - The SQRLs are preliminary and may change based on Site Visit information and further discussion by Evaluation Panels.
  - Questions may also be sent to the study team or verbalized during the Site Visit.
  - Questions must be of significance to a Form A, B, C, D, or E rating.
- **The Astrophysics Explorers Program Scientist will approve all SQRLs developed at the Initial Plenary. Three types of responses are planned for SQRLs. These types may be combined for a given Significant Weakness (SW), Question (Q), or Request For Information (RFI).**
  - Written response prior to Site Visit: SQRLs provided to the Study team that must be addressed in writing prior to the Site Visit. The nature of some SQRLs require data that must be reviewed prior to the Site Visit.
  - Written response at Site Visit: SQRLs that require documentation, but not extensive review.
  - Oral presentation at Site Visit: SQRLs that must be addressed the day of the Site Visit by way of presentation.
- Evaluation Team members will ask questions during the Site Visit to ensure they understand the response to a SQRL, or to clarify any significant issues.

Site Visits

- Site Visits with Oral Briefings will be used to clarify implementation details and commitments. The Study Team may address weaknesses identified in the Concept Study and provide updates on the Concept Study developed after submission of the Concept Study Report.
- Site Visits for the 2021 Astrophysics MIDEX and MO down-selects will be held in-person.
- Briefings at each Site Visit will be limited to 7 presentation hours and up to 1 additional hour for an optional tour/demonstration equally divided over 2 days, with 15 additional minutes for SC on one of the 2 days. Breaks are not included in the 7-hour maximum time for the site visit presentations/discussions or the 1-hour maximum time for an optional tour/demonstration. Suggest a schedule of 8:30 a.m. – 1:00 p.m. local time.
- All Site Visit presentations/briefings should be in a plenary session with all Evaluation Team members attending – no splinter sessions – unless authorized by the Astrophysics Explorers Program Scientist.
- Written SQRLs will be submitted to the PI 7 days before the Site Visit. All teams will have the same lead time, excluding federal holidays.
- As part of the Site Visit process, NASA may send additional SQRLs to Study Teams at 6:00pm on the 2nd Site Visit day, with responses due within 5 days. Additional SQRLs may be sent once during the time period of October 3-11, 2023, with responses due within 48 hours (exact dates for this set will be communicated to each Study Team). A final set of SQRLs may also be sent during the time period of October 16-26, with responses due within 24 hours.
- All information provided by the Study Team is relevant to the evaluation. Information contained in the CSR, information presented during the Site Visit; and information provided in response to SQRLs will all be considered and will be treated as updates and clarifications to the CSR during the evaluation.

Final Plenary Products

- Finalize all evaluation Forms based on the information in the CSRs, as well as updates to the CSRs and clarifications.
- Both Major and Minor Strengths and Weakness will be considered in the Grade for all Forms.

Form B

- Polling will be held twice on the Form B grade. The final polling is recorded. For the final polling, the individual grades are recorded, and the median grade is calculated and recorded as the final polling. A median score that falls between two grades will be “rounded” in the direction of the mean score; if mean and median are equal, the score will be “rounded” towards the less favorable grade (e.g., 10 Good votes and 10 Good/Fair votes = Good/Fair grade). If there is a divergence of opinion, there may be additional rounds of discussion and polling.
- SWs, Qs, and/or RFIs generated during the Final Plenary may result in additional rounds at or after the Final Plenary.

Form C

- Form C will be reviewed three times. Polling will be held twice on the Form C risk rating. The final polling is recorded and reported. For the final polling, the individual grades are recorded, the median calculated and the final grade recorded which reflects the Form C risk rating of the median of the polling. A median score that falls between two risk ratings will be “rounded” to the higher risk rating.
- If there is a divergence of opinion, there may be additional rounds of discussion and polling.
- SWs, Qs, and/or RFIs generated during the Final Plenary may result in additional rounds at or after the Final Plenary.

Form D, Student Collaboration

- Representatives from the SC Panel will consider the Merit of proposed Student Collaborations.

Form E, Small Business Subcontracting

- Representatives from the Small Business Panel will evaluate this criterion.

Observers and Transition Briefing

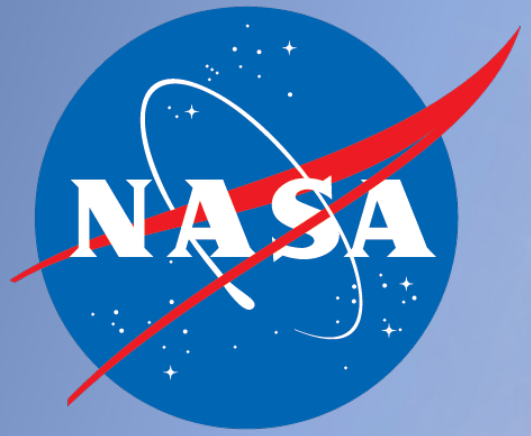
- Civil Servants (CSs), Intergovernmental Personnel Act Assignees (IPAs), and Contractors with downstream implementation responsibilities may attend panel meetings and Site Visits as Observers.
- All invited observers must be approved by both the SMD Program Officer and Deputy Associate Administrator for Research.
  - Observers must comply with SMD Policy Document SPD-17, *Statement of Policy on Observers at Panel Reviews of Proposals*. This policy will be provided to all approved observers.
- Approved Observers include: (this list will be updated as Observers are approved):

Name	Affliation	Name	Affliation
Nicholas Chrissotimos	EHPD, NASA/GSFC	Catherine Peddie	EHPD, NASA/GSFC
Mark Goans	EHPD, NASA/GSFC	Christine Hinkle	EHPD, NASA/GSFC

  - The above listed Program Office individuals are invited due to their positions in organizations which will oversee implementation of the down-selected mission(s). Their participation as Observers will provide early knowledge of any potential implementation challenges for the down-selected mission(s).
  - Program Executive: Lucien Cox
  - New SOMA Acquisition Managers (Renee Lake, Joe McKenney, Sheila Nash-Stevenson, Omar Torres, and Elisabeth Morse) will attend some events for training purposes. Their attendance at site visits will be limited to one or two people.
  - After down-selection is announced, Transition Briefings will be provided by a subset of the Evaluation Team to CSs, IPAs, and Contractors in the Program Office and at NASA HQ who have implementation responsibilities.

Change Log

#	Date	Change
0	May 9, 2023	Baseline


NASA